

# A COST-EFFECTIVE METHOD FOR CONSTRUCTING MAGNETIC FUMICELS FOR HERBARIUM CABINETS

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## ABSTRACT

A method is described to construct magnetic fumicel packets for holding solid insect repellants (e.g., naphthalene and paradichlorobenzene) used in the herbarium. The fumicels are designed to attach magnetically to metal herbarium cabinets. They are made entirely of archival materials, and are inexpensive and easily assembled.

## RESUMEN

Se describe un método para construir contenedores magnéticos de fumicel para contener repelentes de insectos sólidos (por ej. naftaleno y paradichlorobenzeno) usados en el herbario. Los fumiceles se diseñan para ser adheridos magnéticamente a las cabinas metálicas del herbario. Están realizados completamente en materiales de archivo, y son baratos y fáciles de ensamblar.

## INTRODUCTION

Substantial literature exists on the importance and efficacy of various pest repellants in herbaria and their health risks (e.g., Hall 1988; Strang 1999). However, methods for containing and securing repellants such as naphthalene and paradichlorobenzene (PDB) in herbarium cabinets have received little attention. A variety of methods are used for containment in herbaria, e.g., cloth bags with drawstrings, paper envelopes, small paper bags, small cardboard boxes, or small compartments in cabinet doors, and some entomologists use fumicels constructed from small cardboard boxes with wire mesh tops (Anonymous 2012). Because naphthalene and PDB vapors are heavier than air and tend to settle at the bottom of the cabinet, the repellant is normally placed on top of the uppermost folder of specimens in the uppermost pigeonhole of each column of the herbarium cabinet. However, there are several annoying aspects of this widely used method. When specimens are retrieved from the uppermost pigeonholes, the packets of repellant fall out, often striking the individual removing the specimens, or the packets are inadvertently pushed toward the back of the pigeonhole where they slip out of sight. Retrieving the "lost" packets usually requires use of a ladder or step-stool, which is time-consuming and potentially hazardous.

I devised, tested, and recommend placement of solid repellant in fumicels constructed from acid-free glassine envelopes suspended from the metal ceilings of herbarium cabinets by small neodymium magnets affixed to small rectangles cut from herbarium paper. This method uses archival materials, is cost effective, and—except for magnets and glassine envelopes—employs materials commonly available in the herbarium.

## MATERIALS AND METHODS

In the United States, neodymium magnets and glassine envelopes are normally sold by English units; thus, English units are primarily employed here. Paper magnet-holders were made from  $2\frac{1}{2}$  inch  $\times$   $3\frac{1}{2}$  inch [6.4 cm  $\times$  8.9 cm] paper rectangles cut from 0.12 caliper archival herbarium paper using a guillotine type paper cutter. The center of each rectangle was marked using a wooden pencil, and a  $\frac{1}{4}$  inch  $\times$   $\frac{1}{16}$  inch [6.4 mm  $\times$  1.6 mm] N42 neodymium (NdFeB) disc magnet was affixed at the center with a small dot of water-base herbarium glue. The adhesive was allowed to dry, and the paper magnet-holder was placed in a  $2\frac{3}{4}$  inch  $\times$   $3\frac{3}{4}$  inch [7 cm  $\times$  9.5 cm] acid-free, glassine envelope with a single opening along one  $2\frac{3}{4}$  inch end and a foldable end flap. Approximately 10g of naphthalene (three Enoz® moth-balls) was placed in the packet against the surface of the paper magnet-holder opposite the magnet. The envelope was closed, and a  $1\frac{1}{4}$  inch stainless steel paper-clip was



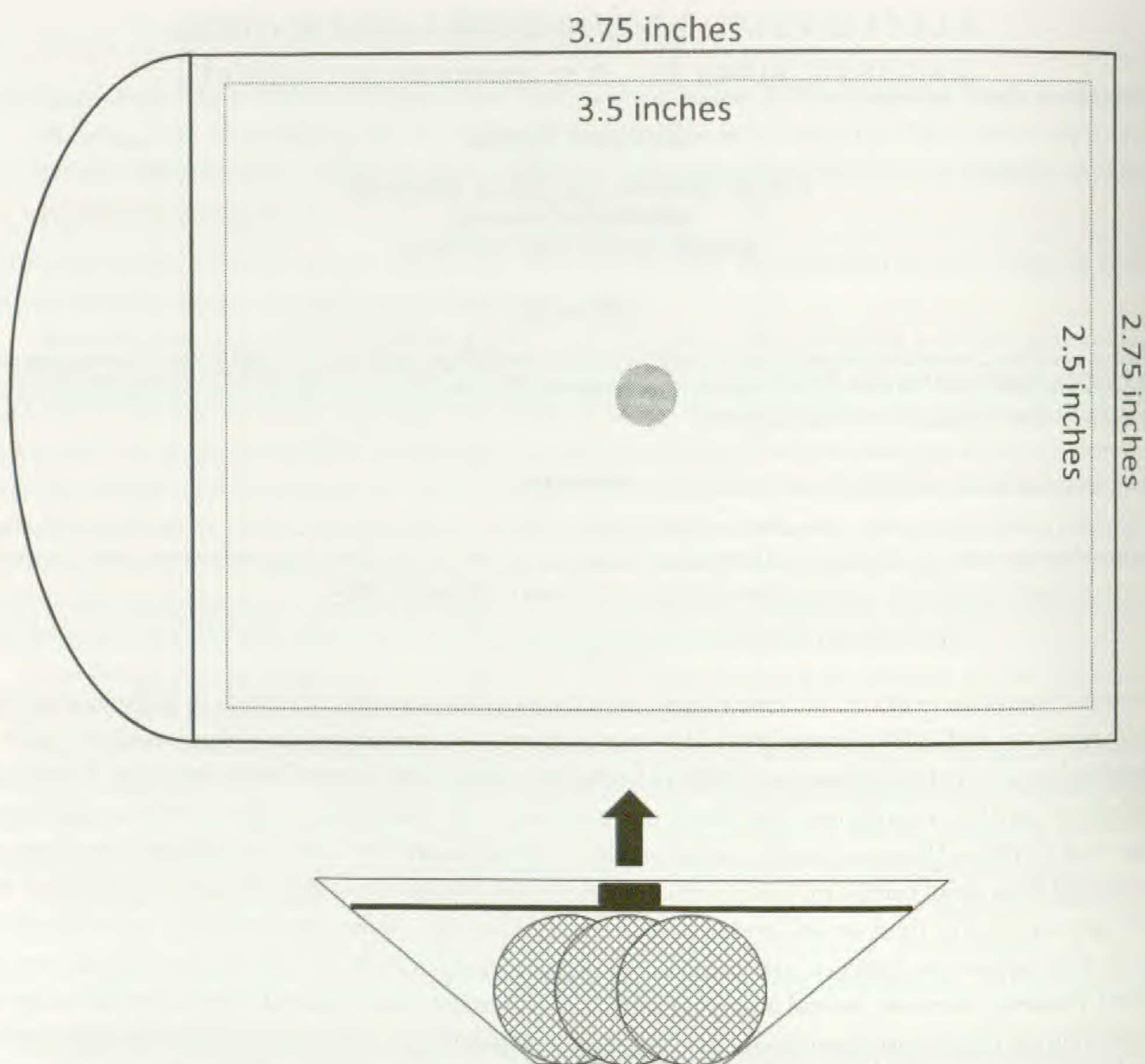


FIG. 1. Schematic diagram of fumigel showing inner paper rectangle with attached magnet (magnet-holder) enclosed within outer glassine envelope with open flap.

FIG. 2. Schematic cross-section of fumigel showing three naphthalene moth-balls suspended beneath paper magnet-holder. Arrow represents direction of magnetic attachment to metal surface of cabinet.

placed across one corner to secure the flap. See Figs. 1, 2 and 3. Alternatively, the loose flaps can be taped closed, but this would most likely prevent reuse of envelopes. Glassine paper is relatively non-porous and impervious. Therefore, I punctured the lower surface of each glassine envelope about 20 times with a steel sewing needle to increase its permeability to naphthalene.

**Magnets.**— $\frac{1}{4}$  inch  $\times$   $\frac{1}{16}$  inch [6.4 mm  $\times$  1.6 mm] Grade N42 Neodymium (NdFeB) Disc Magnet, 3 $\times$  nickel plated, pull force 2.5 lbs: MAGNETman<sup>®</sup> via amazon.com<sup>®</sup>. <http://www.amazon.com/shops/A2WOM254L-CFKNF>

**Glassine envelopes.**— $2\frac{3}{4}$  inch  $\times$   $3\frac{3}{4}$  inch [7 cm  $\times$  9.5 cm] acid-free, glassine envelope with foldable end flap and single opening along  $2\frac{3}{4}$  inch end: Uline<sup>®</sup>, 12575 Uline Drive, Pleasant Prairie, WI 53158, USA. <http://www.uline.com/>.

#### RESULTS AND DISCUSSION

The major expense was the cost of the neodymium magnets (\$0.24 each, including shipping; pack of 100 for \$12.99, excluding shipping), the acid-free, glassine envelopes (\$0.07 each, including shipping; box of 1000 for





FIG. 3. Photograph of magnetic fumicel suspended from metal ceiling of herbarium cabinet.

\$61.00, excluding shipping), and stainless steel paper-clips (\$0.07 each, including shipping; box of 500 for \$29.95, excluding shipping). The cost of the other, commonly used materials was negligible. Thus, I equipped 90 herbarium cabinets, each with two fumicels, at a cost of less than \$0.40 per fumicel. Although I recommend attaching the fumicels to ceilings of cabinets, they also seem to work well on cabinet doors, which might be a consideration when the uppermost pigeonholes are packed with specimens.

Relative to their size, neodymium magnets are very strong, and they are readily available from several online vendors. Marketed as permanent, they are subject to chipping if allowed to snap together. Although I used only about 10g of repellent per fumicel, these small magnets are sufficiently strong to suspend at least 20g of solid repellent (i.e., six moth-balls and the maximum capacity of the fumicel envelope) securely, and they can be easily detached from the herbarium cabinet. In addition to being dangerous, larger, stronger neodymium magnets are more expensive and would require considerable effort to detach from the metal surface of the cabinet. Moreover, detaching them would most likely result in tearing both glassine envelope and paper magnet-holder. Both magnet grade and size recommended herein seem ideal for this particular application. However, neodymium magnets come in a variety of sizes and shapes, and heavier containers could easily be attached with larger, stronger magnets.

**Disclaimer.**—This article should not be construed to be a recommendation by either the author or this journal for using naphthalene, PDB, or other pest repellants in herbaria. Rather, its purpose is to provide information that might be beneficial to those who find it necessary to use repellants or other solid materials such as desiccants as a part of the overall program for herbarium pest management.

#### ACKNOWLEDGMENTS

Student assistant Zachary J. Buning is gratefully acknowledged. The constructive criticism of Wendy B. Zom-



lefer (GA), Kent D. Perkins (FLAS), and Melanie Link-Perez (AASU) improved this paper. This work was supported in part by NSF DBI-1054366 (J.R. Carter, PI).

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